FORM PTO-1390 (Modified) (REV 11-98) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR
PF980079	09/856063

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FR99/02863	22November1999(22.11.99)	25November1998(25.11.98)

TITLE OF INVENTION
METHOD FOR MANAGING BANDWIDTH IN A COMMUNICATION NETWORK COMPRISING A CORDLESS CONNECTION

APPLICANT(S) FOR DO/EO/US
Helmut Buerklin, Yvon Legallais and Gilles Straub

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210). attached to Item 13
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98. with references attached
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☒ Certificate of Mailing by Express Mail 20. Return postcard receipt
20. ☒ Other items or information

CERTIFICATE OF MAILING UNDER 37 CFR 1.10

EL685391181US — "Express Mail" mailing no.

May 17, 2001 — Date of Deposit

I hereby certify that this application is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Davida Fornarotto — Typed or printed name of person mailing application

Davida Fornarotto — Signature of person mailing application

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/856063	PCT/FR99/02863	PF980079

21. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

	CALCULATIONS PTO USE ONLY
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO $1000.00	
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but Internation Search Report prepared by the EPO or JPO $860.00	
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO $710.00	
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) $690.00	
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =	860.00
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	12 - 20 =	0	x $18.00	
Independent claims	1 - 3 =	0	x $80.00	
Multiple Dependent Claims (check if applicable).			☐	

TOTAL OF ABOVE CALCULATIONS =	860.00
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable).** ☐	
SUBTOTAL =	860.00
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +	
TOTAL NATIONAL FEE =	860.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐	
TOTAL FEES ENCLOSED =	860.00
Amount to be: refunded	$
charged	$ 860.00

☐ A check in the amount of to cover the above fees is enclosed.

☒ Please charge my Deposit Account No. 07-0832 in the amount of $860.00 to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 07-0832 A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Mr. Joseph S. Tripoli
THOMSON multimedia Licensing Inc.
Patent Department
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SIGNATURE

Paul P. Kiel
NAME

40,677
REGISTRATION NUMBER

May 17, 2001
DATE

EXPRESS MAIL LABEL NO. EL685391181US

PF980079

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Helmut Buerklin, Yvon Legallais and Gilles Straub

Filed : Herewith

For : METHOD FOR MANAGING BANDWIDTH IN A COMMUNICATION NETWORK COMPRISING A CORDLESS CONNECTION
(amended by Preliminary Amendment)

PRELIMINARY AMENDMENT

Hon. Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Sir:

In the US national phase application of PCT/FR99/02863 filed herewith, please enter the following amendments:

IN THE TITLE:

Please amend the title to read: "METHOD FOR MANAGING BANDWIDTH IN A COMMUNICATION NETWORK COMPRISING A CORDLESS CONNECTION".

IN THE SPECIFICATION:

Please amend the specification as follows:

On Page 1, after the title, please insert the first paragraph as follows:

-- This application claims the benefit of French application no. 9814852 filed November 25, 1998, which is hereby incorporated herein by reference, and which claims the benefit under 35 U.S.C. § 365 of International Application

PCT/FR99/02863, filed November 22, 1999, which was published in accordance with PCT Article 21(2) on June 2, 2000.--

IN THE CLAIMS:

Please amend the claims (which are the annexes of the International Preliminary Examination Report) as follows. A marked up version of the amended claims is attached herewith.

1.(AMENDED) Process for managing isochronous resources in a communication network comprising at least two communication buses linked by way of a wireless transmission bridge, the bridge comprising for each bus a real portal connected to this bus, each portal being furnished with wireless communication means, wherein the process comprises the steps of:

- modelling the wireless bridge by each real portal in the form of virtual buses and virtual bridges, each virtual bridge comprising two virtual portals;
- emulating a global register of passband availability for the set of wireless links of the wireless bridge;
- reserving passband with the global register for the virtual buses representing each wireless link participating in a communication between two real portals.

2.(AMENDED) Process according to Claim 1, wherein a wireless link is modelled in the form of a virtual bridge.

3.(AMENDED) Process according to Claim 1, wherein a wireless link is modelled in the form of a virtual bus.

4.(AMENDED) Process according to Claim 1, wherein a group of wireless links linking a group of portals having complete connectivity within a bigger network with partial connectivity is modelled in the form of a virtual bus.

5.(AMENDED) Process according to Claim 3, wherein each real portal emulates;

- a virtual portal forming together with the real portal a bridge linking the communication bus connected to the real portal to a virtual so-called internal bus also emulated by the real portal;
- a virtual bridge for each wireless link with another real portal.

6.(AMENDED) Process according to Claim 2, wherein each real portal emulates:

- a virtual portal forming together with the real portal a bridge linking the communication bus connected to the real portal to a virtual so-called internal bus also emulated by the real portal;
- a virtual portal for each wireless link with other portals of the wireless bridge, two virtual portals corresponding to the same wireless link between two real portals forming a virtual bridge representing the wireless link.

7.(AMENDED) Process according to Claim 4, wherein it furthermore comprises the step of eliminating an internal bus and virtual portals connected thereto, and of contracting into a bridge the two orphan portals thus created, in the case where the real portal comprising the internal bus forms part of a single wireless link.

8.(AMENDED) Process according to Claim 1, wherein it furthermore comprises the step of determining, by each real portal, the set of wireless links between the real portals.

9.(AMENDED) Process according to Claim 8, wherein the step of determining the set of wireless links comprises the steps of:

- identifying, by each real portal, the other real portals whose data reach it directly;
- transmission destined for all the other real portals of the wireless network, of the list of real portals with which a direct link exists;
- reception of the list compiled by each of the other portals.

10.(AMENDED) Process according to Claim 1, wherein it also comprises the step of emulating a register of availability of isochronous channels for each virtual bus.

11.(AMENDED) Process according to Claim 1, wherein the step of reserving passband with the global register comprises the instigating of a request for reserving passband with a manager of isochronous resources of a virtual bus and for transmitting the request by the said manager of isochronous resources of the virtual bus to a software module managing the global register of passband availability.

12.(AMENDED) Process according to Claim 1, wherein the bridge comprises at least three portals.

IN THE ABSTRACT:

Please add the following Abstract.

-- The invention relates to a process for managing resources in a communication network comprising at least two communication buses linked by way of a wireless transmission bridge, the said bridge comprising for each bus a real portal connected to this bus, each portal being furnished with wireless communication means. The process is characterized by the steps:

- modelling the said wireless bridge by each real portal in the form of virtual buses and virtual bridges, each virtual bridge comprising two virtual portals;
- emulating a global register of passband availability for the entire wireless bridge;
- reserving passband with the said global register for each wireless link participating in a communication.

The invention applies in particular in field of home automation. --

REMARKS

The title has been amended to conform with the translated title of the published application (WO 00/31911).

The specification has been amended to include a reference to the priority applications.

The claims have been amended to remove multiple dependencies and to meet the requirements of the United States.

To meet the requirements of the United States, the Abstract (as originally filed in the PCT application) is added.

No fee is believed to have been incurred by virtue of this amendment. However if a fee is incurred on the basis of this amendment, please charge such fee against deposit account 07-0832

Respectfully submitted,
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May 17, 2001

MARKED UP VERSION OF THE AMENDED CLAIMS

1.(AMENDED) Process for managing isochronous resources in a communication network comprising at least two communication buses linked by way of a wireless transmission bridge, the bridge comprising for each bus a real portal connected to this bus, each portal being furnished with wireless communication means, [characterized in that] wherein the process comprises the steps of:

- modelling the wireless bridge by each real portal in the form of virtual buses and virtual bridges, each virtual bridge comprising two virtual portals;
- emulating a global register of passband availability for the set of wireless links of the wireless bridge;
- reserving passband with the global register for the virtual buses representing each wireless link participating in a communication between two real portals.

2.(AMENDED) Process according to Claim 1, [characterized in that] wherein a wireless link is modelled in the form of a virtual bridge.

3.(AMENDED) Process according to Claim 1, [characterized in that] wherein a wireless link is modelled in the form of a virtual bus.

4.(AMENDED) Process according to Claim 1, [characterized in that] wherein a group of wireless links linking a group of portals having complete connectivity within a bigger network with partial connectivity is modelled in the form of a virtual bus.

5.(AMENDED) Process according to [one of Claims 3 or 4, characterized in that] Claim 3, wherein each real portal emulates;

- a virtual portal forming together with the real portal a bridge linking the communication bus connected to the real portal to a virtual so-called internal bus also emulated by the real portal;
- a virtual bridge for each wireless link with another real portal.

6.(AMENDED) Process according to Claim 2, [characterized in that] wherein each real portal emulates:

- a virtual portal forming together with the real portal a bridge linking the communication bus connected to the real portal to a virtual so-called internal bus also emulated by the real portal;
- a virtual portal for each wireless link with other portals of the wireless bridge, two virtual portals corresponding to the same wireless link between two real portals forming a virtual bridge representing the wireless link.

7.(AMENDED) Process according to [one of Claims 4 or 5, characterized in that] Claim 4, wherein it furthermore comprises the step of eliminating an internal bus and virtual portals connected thereto, and of contracting into a bridge the two orphan portals thus created, in the case where the real portal comprising the internal bus forms part of a single wireless link.

8.(AMENDED) Process according to [one of Claims 1 to 7, characterized in that] Claim 1, wherein it furthermore comprises the step of determining, by each real portal, the set of wireless links between the real portals.

9.(AMENDED) Process according to Claim 8, [characterized in that] wherein the step of determining the set of wireless links comprises the steps of:

- identifying, by each real portal, the other real portals whose data reach it directly;
- transmission destined for all the other real portals of the wireless network, of the list of real portals with which a direct link exists;
- reception of the list compiled by each of the other portals.

10.(AMENDED) Process according to [one of the preceding claims, characterized in that [Claim 1, wherein it also comprises the step of emulating a register of availability of isochronous channels for each virtual bus.

11.(AMENDED) Process according to [one of the preceding claims, characterized in that] Claim 1, wherein the step of reserving passband with the global register comprises the instigating of a request for reserving passband with a manager of isochronous resources of a virtual bus and for transmitting the request by the said manager of isochronous resources of the virtual bus to a software module managing the global register of passband availability.

12.(AMENDED) Process according to [one of Claims 1 to 11, characterized in that] Claim 1, wherein the bridge comprises at least three portals.

Process for managing passband in a communication network comprising a wireless link

The IEEE 1394 1995 standard relates to the configuration and management of one or more serial communication buses. Work is in progress to produce an extension of this standard covering networks made up of several buses interconnected by way of assemblies referred to as 'bridges'. This extension, termed P1394.1, currently exists in the form of a preliminary draft of version 0.03, dated October 1997. According to this draft, a bridge is made up of a pair of devices referred to as portals, each of the two portals being connected to one out of two buses to be linked. The two portals are linked to one another by a switching matrix (or 'switching fabric'). The specification of the switching matrix of the bridge is outside the framework of P1394.1 and is left to the implementer to deal with. Currently, no bridges possessing more than two portals are provided for, given that it is possible to model any connection of more than two buses by a limited number of bridges connecting pairs of buses only.

The interconnecting of several buses as mentioned in the above paragraph can also be performed by way of wireless links, for example by radio frequency (RF) transmission. Figure 1 is an example of a wireless bridge between four 1394 buses. Each of the buses 1 to 4 is linked to a portal of the bridge, the portals being identified by the letters A to D. The bridge of Figure 1 is an example of incomplete connectivity in the sense that the bridge comprises at least one portal which cannot communicate directly with another portal. Within the framework of the example, there is no direct link between the portals A and D.

The IEEE 1394 1995 standard describes an isochronous transmission procedure, in which an apparatus ('node') wishing to transmit data first makes a reservation of a certain number of isochronous channels. One of the nodes of the bus possesses the

'BANDWIDTH_AVAILABLE' and 'CHANNEL_AVAILABLE'. A node makes a reservation for isochronous resources with the manager of isochronous resources by reading the registers and by updating their content according to its requirements.

The reservation process described in the document IEEE 1394 1995 is not however suited to the network of buses connected by a wireless bridge such as that of Figure 1. Specifically, if the portal A has to perform a transmission of passband of width X to the portal D, a passband of width 2X will be required in total: the portal A must reserve a first passband of width X for the transmission from A to, for example, C, then a second passband of width X for the transmission from C to D. Stated otherwise, the passband depends on the connectivity existing in the network: this type of configuration is not taken into account by the current IEEE 1394 1995 standard.

The document 'P1394.1 Draft Standard for High Performance Serial Bus Bridges - Draft 0.03 October 18, 1997' defines a bridge between two communication buses, the bridge consisting of two portals.

The document "Reservation of bridge resources proposal for January 26 p1394.1 working group" by K. Toguchi et al., January 1998 also relates to a bridge with two portals.

The document "Proposals in consideration of wireless bridge fabric" by Sugita et al., March 1998 relates to bridges with more than two portals.

The subject of the invention is a process for managing isochronous resources in a communication network comprising at least two communication buses

linked by way of a wireless transmission bridge, the said bridge comprising for each bus a real portal connected to this bus, each portal being furnished with wireless communication means, characterized in that the said process comprises the steps of:

- modelling the said wireless bridge by each real portal in the form of virtual buses and virtual bridges, each virtual bridge comprising two virtual portals;

- emulating a global register of passband availability for the set of wireless links of the wireless bridge;

- reserving passband with the said global register for the virtual buses representing each wireless link participating in a communication between two real portals.

The centralizing of the global register of passband availability function into a single register for all the modelled buses of the wireless bridge makes it possible to make passband reservations globally for this wireless bridge. By transmitting passband reservation requests received on modelled buses to this single register, the centralizing of the function is made transparent to a node making the reservation.

Other characteristics and advantages of the invention will become apparent through the description of two particular non-limiting exemplary embodiments described with the aid of the appended figures among which:

- Figure 1 is a diagram representing a wireless bridge between several buses;

- Figure 2 is a diagram representing a modelling of the bridge of Figure 1 by use of virtual buses according to a first exemplary embodiment;

- Figure 3 is a diagram representing the real and virtual elements of the node A of Figure 2;

- Figure 4 is a time chart explaining the exchanges of messages between the elements of the network within the framework of a reservation of resources;

- Figure 3 represents a modelling of the bridge of Figure 1 by use of virtual bi-portal bridges according to a second exemplary embodiment;

- Figure 4 is a diagram representing the real and virtual elements of the node A of Figure 5;

- Figure 7 is a simplification of the modelling according to a first variant of the first exemplary embodiment;

- Figure 8 is an additional simplification of the modelling of Figure 7 according to a second variant of the first exemplary embodiment;

- Figure 9a is a diagram representing a modelling of a particular example of a bond between two nodes, according to the first exemplary embodiment;

- Figure 9b is a diagram representing a simplification of the modelling of Figure 9a according to a second variant of the first exemplary embodiment;

- Figure 10a is a diagram representing a modelling of a particular example of a bond between two nodes according to the second exemplary embodiment;

- Figure 10b is a diagram representing a simplification of the modelling according to a variant of the second exemplary embodiment.

French Patent Application 98 04982 of 21 April 1998 filed in the name of THOMSON multimedia and bearing the title 'Procédé de synchronisation dans un réseau de communication sans fil' [Process of synchronization in a wireless communication network] also relates to a wireless bridge linking several communication buses, in particular of the IEEE 1394 1995 type. This patent application constitutes the priority application of PCT application WO99/55028, published on 28/10/1999 and may be consulted in the public dossier for the latter application.

According to a first exemplary embodiment, a decomposition of a multi-portal bridge into a given number of bi-portal bridges is carried out by

representing a connection between two portals by a virtual bus.

Such a modelling in the case of the example of Figure 1 is given by Figure 2. The dots define the confines of the various nodes acting as portals. Here we shall distinguish between the concept of node, which encompasses the device itself, as well as the concept of portal, with reference to the prime function of the node. This distinction is made so as to clarify the description which will follow. Specifically, a node can simulate, for example in a software manner, virtual elements such as buses and virtual portals. The real portal (denoted A, B, C or D hereinbelow) of the node is then placed functionally at the same level as the virtual portals, although in reality it is this real portal itself which simulates the virtual elements.

Each node comprises a bridge linking its IEEE 1394 bus to an internal virtual bus. This bridge is composed of the real portal connected to the IEEE 1394 bus and of a virtual portal connected to the internal virtual bus.

Each node furthermore comprises a virtual bridge for each possible wireless link with another node. A wireless link is represented by a virtual bus. A virtual bridge comprises two virtual portals, connected respectively to the internal virtual bus of the node and to the virtual bus representing the wireless link.

The internal virtual buses differ from the virtual buses representing the wireless links by an important aspect as regards the reserving of resources: whereas a virtual bus representing a wireless link possesses a limited passband, this is not the case for the internal bus.

Generally, the following notation is adopted:

b_X Virtual bus of portal X

b_XY Virtual bus between the portals X and Y

that of the control windows of the other nodes. A node transmits its control information in the control window allocated to it, and repeats the information of the control windows of the other nodes. A repeated item of control information is identified as being repeated by the use of a repetition counter and which is incremented each time the item of control information is repeated by a node. When a node A receives an item of control information of a node X in the control window of this node X, then the node A deduces therefrom that this information item reaches it directly from the node X. Conversely, if the node A receives the control information of the node X in a control window other than that of the node X, then this information item has been repeated and has not reached it directly. Thus, on the one hand, the control information is propagated to all the wireless nodes of the wireless bridge, even if the connectivity there is incomplete, on the other hand each node can determine whether the information which it receives originates directly from another node, or whether it has been repeated.

Within the framework of the present exemplary embodiment, each time a new node is plugged in, it issues a calibration request by inserting it into its control window. This request comprises a flag for each of the nodes of the wireless network. A flag of order j is set to the value 1 if the node issuing the request can receive node j, that is to say if a direct wireless link exists. This request is then propagated throughout the network using the aforesaid mechanism of the control windows. A node detecting a calibration request in a newly occupied control window also generates a calibration request.

At the end of calibration, that is to say once each node has issued its calibration request and it has been transmitted to all the other nodes, each node is aware of what are the direct wireless links in the

wireless bridge. Each node can then proceed to the modelling and emulation of the buses and portals which relate to it, according to the rules which were set forth earlier.

As in the case of the IEEE 1394 1995 standard, a manager of isochronous resources is designated for each bus, although in the present case these are virtual buses and not real buses.

Two cases arise: the election of an isochronous resources manager for an internal virtual bus, and the election for a virtual bus representing a wireless link.

In each case, the designation of an isochronous resources manager apparatus can be made in various ways. The two methods described hereinbelow are given by way of example.

According to the present exemplary embodiment, the element elected manager of isochronous resources on an internal virtual bus is always the virtual portal of the bridge which also comprises the real portal of the node. If the node is the node X, the virtual portal elected for the internal virtual bus b_X is the portal p_X.

According to the present exemplary embodiment, the election of the manager of isochronous resources on a virtual bus representing a wireless link is made as follows:

(1) Each node A, B, C, D reads from a memory of the other nodes an identifier of the node called 'EUI64' in the 1394 1995 document. This identifier, unique to each apparatus, possesses a length of 64 bits.

(2) The order of the bits of the identifiers is inverted, that is to say the least significant bit takes the place of the most significant bit, the second least significant bit takes the place of the second most significant bit and so on.

(3) Each node determines for each wireless link the larger out of the inverted identifier of the node on the other side of the link and its own identifier. If the larger identifier is that of the node on the other side of the link, then the manager of isochronous resources of this link is the virtual portal p_XY.Y, where X designates the node performing the determination on its behalf and Y designates the node on the other side of the link. In the converse case, it is the portal p_XY.X which is designated.

Thus, the isochronous resources managers are designated unambiguously. The isochronous resources managers are also designated as roots of their buses, in the sense of the IEEE 1394 1995 standard. Each isochronous resources manager manages a register of availability of isochronous channels, which is similar to the 'CHANNEL_AVAILABLE' register described by the IEEE 1394 1995 document in section 8.3.2.3.8, and which is accessible in a similar manner. Access to this register, as well as to the register of availability of wireless passband will be seen in greater detail in conjunction with Figure 4.

According to the present example, the nodes A, B, C and D furthermore elect a manager of the passband of the wireless bridge. Unlike the isochronous resources managers, the number of which depends on the number of possible wireless links, the function of manager of the isochronous passband is a function centralized at the level of a single device for the entire wireless bridge.

It is recalled that according to the IEEE 1394 1995 standard, the manager of isochronous resources of each bus manages both the passband availability register and the channels availability register.

Various methods can be used to determine unambiguously the passband manager from among the various elements of the network. According to the present exemplary embodiment, this task is entrusted to

the real portal possessing the largest inverted node identifier. As previously, each node determines the passband manager by analysing the identifiers of all the nodes of the network.

The passband manager manages a wireless passband availability register similar to the passband availability register ('BANDWIDTH_AVAILABLE') defined in section 8.3.2.3.7 of the IEEE 1394 standard, and access to which by the various elements of the network is also similar. The register is initialized to a given value corresponding to the passband available on the wireless network, for example 32 Mbit/s.

A device connected to one of the real buses 1 to 4 must, to communicate with a device of another bus, configure the bridges and virtual and real buses which link it to the device of the other bus.

Figure 4 illustrates the exchanges employed to perform a reservation of isochronous resources on the wireless bridge for the purpose of establishing a channel between a decoder 5 (see Fig. 1) connected to the IEEE 1394 bus 1 and decoder 6 connected to the IEEE 1394 bus 3.

The configuration process relating to the IEEE 1394 buses 1 and 3 is that defined by the IEEE 1394 1995 standard and will consequently not be tackled in detail.

For the requirements of the example, the real portal B has been elected passband manager of the wireless bridge. The virtual portals p_A, p_AC.A and p_C are respectively the managers of isochronous resources of the buses b_A, b_AC and b_C.

The decoder 5 must perform reservations of isochronous channels and of passband with the corresponding managers of the buses b_A, b_AC and b_C. It must also make a passband reservation with the portal B.

According to a first step (E1), the decoder 5 performs a request for reading the content of the

register of availability of isochronous resources of the bus b_A. The address of the manager of isochronous resources of this bus is composed of the address bus and of a shift value ('offset') for the manager, and the value of which is determined by the IEEE 1394 1995 standard. The request is in fact recovered by the real portal A, which detects the address of the bus b_A in the request and determines whether the virtual portal p_A is emulated by itself or by another node. Given that the portal p_A is indeed emulated by the real portal A, the latter also emulates the manager of isochronous resources of the bus b_A, as well as the register of availability of isochronous resources of this bus. The content of this register is sent back (E2) to the decoder. The register identifies those out of the 64 channels which are used and those which are free, by the value of one bit per channel. To make the reservation of channels, the decoder 5 transmits a latching request (E3) which comprises the value previously read from the register, as well as a new value written thereto. This new value indicates, in addition to the channels already identified as reserved in the value read, these two channels which the decoder seeks to reserve. The portal p_A compares the old value with that contained in its register of availability of isochronous resources. If this value is identical, the portal writes the new value into the register and indicates to the decoder that the reservation is made. It is assumed that this is the case in the example of Figure 3 (step E4). If the two values are not identical, then the content of the register has been modified by another apparatus between the moment of the reading thereof and of the latching request by the decoder 5. The content of the register is then not modified. The decoder 5 is informed thereof, and may possibly perform a new attempt at reservation. This register is initialized to the same value as that of

the real bus to which the real portal A (for example) is connected.

A passband availability register is implemented also at the level of a virtual bus without passband limitation. Should passband be reserved at the level of such a bus, the content of the register is decremented accordingly. The advantage of emulating this behaviour is that it satisfies the bus management advocated by the IEEE 1394 1995 document. Within the framework of the present example, the decoder 5 will also attempt to make requests for reading and for latching a passband availability register with a passband manager of the bus A.

The decoder 5 then reserves in the same way the isochronous channels on the bus b_AB, by addressing a reading request to the manager of isochronous resources of this bus, then a request for latching with the portal p_AC.A (steps E5 and E6).

To comply with the IEEE 1394 1995 standard, a device seeking to reserve passband on a virtual bus addresses itself to the manager of isochronous resources of this virtual bus, as if it were a real bus. This is the case even if the manager of the isochronous resources is not the manager of the passband of the wireless bridge. Nevertheless, the manager of isochronous resources knows the address of the passband manager of the wireless bridge, and transmits the request of the initial device by means of this address to the real portal which emulates this function. The manager of isochronous resources also recovers the response to the request on the part of the wireless passband manager, and transmits it to the device. As far as the latter is concerned, everything therefore takes place as if it were making a reservation on a real bus. The centralizing of the passband manager functionality on the wireless bridge is therefore transparent at reservation level.

In the case of the example of Figure 3, to reserve the passband required on the virtual bus b_AC (which is passband limited), the decoder 5 issues a reading request (E7) for the passband register of the wireless network with the portal p_AC.A, which transmits (E8) the request to the portal C. The latter transmits its response (E9) again to the portal p_AC.A, which retransmits to the decoder 5 (E10).

The procedure is similar for the latching/writing request (steps E11 to E14).

Lastly, the reservation of isochronous channel on the internal virtual bus b_C is made with the portal p_C (steps E15 to E18), in the same way as for the reservation on the internal virtual bus b_A.

In the case where an isochronous connection comprises several wireless links, the wireless bridge passband availability register is decremented as many times as necessary, as and when reservations are made.

The reservation of the resources required for transmission has thus been made.

The reservation process just described makes it possible, as already mentioned, to incorporate a wireless bridge into a network of buses, whilst preserving the mechanisms for managing the buses defined by the IEEE 1394 1995 standard and the standards to which it refers, in particular as regards access and management of addresses and registers. What has just been described therefore relates to the view of the wireless bridge seen by an apparatus seeking to communicate with an apparatus on the other side of this bridge. The real operation of the wireless bridge is different. Although the latter simulates several buses, and in particular their managers of isochronous resources and of passband, the resource reservations are not really made other than to the extent that they correspond to the actual operation of the wireless bridge, which has a role of adapting these reservations to its own operation. Within the framework of the

present exemplary embodiment, passband is actually reserved in the manner indicated. The isochronous channels reservation made on its virtual buses therefore has no real significance in respect of the wireless bridge, since a TDMA type mechanism, described in the French patent application already cited, is used by the wireless bridge to transmit data, a mechanism which differs from that implemented on an IEEE 1394 bus. To an isochronous channel transmitted on a real bus, and which has to be transmitted on the wireless network, there corresponds a wireless isochronous channel. This wireless isochronous channel corresponds to a definite constant number of isochronous packets transmitted at each wireless frame. The isochronous packets may be transmitted on the wireless medium in the same format as on an IEEE 1394 bus. The wireless isochronous channel is then defined by the association of the identity of the sender wireless node and of the channel number used on the IEEE 1394 real bus to which the wireless transmitter is connected.

A first variant embodiment of the first example is illustrated by the diagram of Figure 7. This variant makes it possible to simplify the virtual models, and is preferably implemented within the framework of stable wireless bridges, that is to say ones whose wireless links are not modified or modified at relatively large time intervals. Specifically, in the event of incomplete connectivity, these simplified models require that the connectivity of the wireless bridge be completely recalculated with each topological modification of the network of buses.

According to the said simplification, subsets of links are determined. Each wireless node forming part of a link of a subset is linked directly with every other node of this subset. The nodes of a subset are then linked by a virtual bus, this amounting to modelling the set of links between the nodes of a subset by a single virtual bus.

The wireless bridge in the configuration of Figure 1 gives rise to a new model illustrated by Figure 7, with the two groups of links AB, AC, BD and BC, BD, CD.

A second variant of the first exemplary embodiment consists in eliminating from the model of the first exemplary embodiment the internal virtual bus of a node X which possesses a single link, to another node Y. Figure 9a illustrates such a case. The virtual portals connected to this virtual bus are also eliminated. This wireless link is replaced by a bridge made up of the real portal X of the node X and of a virtual portal p_YX.Y managed by the node Y, these two portals being the remaining portals of the two bridges of the eliminated virtual bus. The model has thus been contracted. The remaining semi-virtual bridge thus constituted is illustrated in Figure 9b.

The application of this variant to the example of Figure 7 results in the simplified model of Figure 8.

According to a second exemplary embodiment, a decomposition of a multi-portal bridge into a given number of bi-portal bridges is carried out by representing a wireless link by a virtual bridge. It is recalled that according to the first exemplary embodiment, a wireless link was represented by a bus.

Figures 5 and 6 make it possible to describe this modelling. The dotted lines of Figure 5 indicate the limits of each of the nodes A, B, C, D. The real and virtual elements situated within the limits of a node are managed by the latter. Figure 6 represents the node A and comprises the complete references for each of its elements. These references have not all been plotted in Figure 5 for reasons of clarity.

The modelling is carried out as follows:

Each node comprises a bridge linking its IEEE 1394 bus to an internal virtual bus (b_A, b_B, ...). This bridge is made up of the real portal connected to

the IEEE 1394 bus and of a virtual portal connected to the internal virtual bus. As previously, these portals are denoted respectively X and p_X, where X represents one of the nodes A to D.

Each node X furthermore comprises a virtual portal for each possible wireless link with the other nodes of the wireless network (it is recalled that according to the first exemplary embodiment, each node comprised a virtual bridge for each wireless link and not simply a portal). These portals are denoted p_XY.X, where Y takes in the present case the values B, respectively C, this corresponding to the nodes in direct wireless communication with the node A. Two virtual portals corresponding to the same wireless link between two nodes form a virtual bridge (denoted L_XY, made up of portals p_XY.X and p_XY.Y), this virtual bridge representing the wireless link.

It will be noted that in the case of this second example, the two virtual portals of a virtual bridge are managed by distinct nodes, unlike what was the case in the first exemplary embodiment. It will also be noted that the number of virtual buses and of virtual bridges is reduced with respect to the first exemplary embodiment.

When a controller (for example the decoder 5) wishes to establish an isochronous connection through a network of buses, it can either configure all the buses and the bridges of the path (as described in the previous example), or else despatch a command to the first bridge of the path, then leaving the latter to configure its local bus, and despatch a command to the next bridge of the path.

In the first alternative, the initial controller has complete leeway in selecting a path (from among other possible paths). In the second approach on the other hand, the controller must subcontract choice of path to the various bridges of

the path, each bridge being responsible for finding the next bridge of the path.

The second approach (command approach) is further indicated within the framework of the model based on virtual bridges. Specifically, in this case there is no direct correspondence between a virtual bus and a wireless link, but a direct correspondence between a virtual bridge and a wireless link.

The method of reserving passband described previously does not therefore apply and the following method of reservation is used:

When a controller wishes to establish an isochronous connection between two nodes of the network of buses, it selects from among all the bridges connected by an IEEE 1394 bus to one of the nodes, for example the source node, the bridge which is most indicated for supporting the isochronous connection (for example the one closest to the destination or the least busy, etc.). The controller then generates a command requesting establishment of an isochronous connection to this bridge, and specifies as parameters the address of the destination node (parameters 'bus_ID' and 'node_ID' within the meaning of the IEEE 1394 1995 document), the passband required, and the isochronous channel number used on the local bus (the bus linking the source node and the first bridge). This first bridge makes the reservations necessary on its local virtual bus (channel number, and passband). It then seeks the next bridge most indicated for the requested destination, and despatches it the same command, and so on and so forth up to the last bridge. If for any reason a bridge cannot follow up a command to establish an isochronous connection (lack of resources on the local bus, etc.), it responds negatively to the command. If the resources are available along the path, the command will reach the last bridge, which will respond favourably. The favourable responses are thus relayed gradually up to

the initiating controller, which interrupts this response as an indication that the connection is established.

The principle specific to wireless communication is that each time that a virtual bridge corresponding to a wireless link is traversed, the passband must be reserved with the single manager of the isochronous resources of the wireless network.

If we return to the previous example (Figure 1) of the decoder 5 desiring to establish an isochronous connection between itself and the decoder 6, the following steps are implemented:

- 1 - The decoder 5 reserves a channel number (Y) and the passband (X) on its local IEEE 1394 bus (bus 1).
- 2 - The decoder 5 despatches a command for establishing a connection to the portal A, with the following parameters: (destination: decoder 6, passband X, channel number: Y).
- 3 - The portal A seeks the best path for reaching the decoder 6, it chooses for example to pass through the bridge L_AC.
- 4 - The portal A reserves the channel Y (or by default, another channel), performs the translation of a corresponding header on this channel and reserves the passband X on the virtual bus b_A. The portal A then despatches the command for establishing a connection to the virtual bridge L_AC. The header modification may be rendered necessary by the fact that when a bridge desires to pass an isochronous channel from one bus to another, it may happen that the channel number used on the first bus is already reserved on the second bus. In this case, the bridge must use another channel number on the second bus, and undertake the change of channel number at the level of each isochronous packet of this channel when it passes from the first bus to the second bus.

• 5 - The virtual bridge L_AC makes the passband reservation with the manager of the isochronous resources of the wireless network (here portal B) according to the principle previously set forth (reading of the content of the register, followed by latching). If it has been possible to make the reservation, the procedure continues. Otherwise, the virtual portal L_AC.A responds negatively to the portal A, which responds negatively to the decoder 5.

• 6 - If it was possible to make the passband reservation, the portal L_AC.A makes the reservations on the bus b_C in the same manner as in point 4, then despatches the command to the last bridge (comprising the real portal C and virtual portal p_C).

• 7 - The last bridge makes the channel and passband reservations on the real bus (bus 3) to which the destination node is connected. If it was possible to make the reservations (the resources having been available), it responds favourably to the portal L_AC.A, which responds favourably to the portal A, which responds favourably to the decoder 5. Otherwise the response is negative.

In the case of an isochronous connection requiring transmissions through several wireless links, each bridge L_WZ crossed reserves passband with the single manager of the isochronous resources of the wireless network, thus ensuring consistent management of the wireless resources.

According to a variant embodiment of the second exemplary embodiment, the internal virtual bus of a node X which possesses a single wireless link to another node Y is eliminated, as in the case of the second variant of the first exemplary embodiment. Also eliminated are the two virtual portals connected to this bus. By contraction, a semi-virtual portal is formed, made up of the real portal X and of the virtual portal L_XY.Y. Figures 10a and 10b represent one and

the same model before and after this simplification respectively.

In the case illustrated by Figures 10a and 10b, the node Y forms part of two wireless links. Were the node Y to form part solely of the wireless link XY, then by applying the present simplification, the diagram of Figure 10b would reduce to a bridge linking two real buses and made up of the real portal X and of the real portal Y.

According to the present variant, this wireless link is replaced by a bridge made up of the real portal X of the node X and of a virtual portal p_YX.Y managed by the node Y. This semi-virtual bridge is illustrated in Figure 9. It should be noted that the example of Figure 1 includes no node forming part of only one wireless link.

Claims

1. Process for managing isochronous resources in a communication network comprising at least two communication buses linked by way of a wireless transmission bridge, the bridge comprising for each bus a real portal connected to this bus, each portal being furnished with wireless communication means, characterized in that the process comprises the steps of:

- modelling the wireless bridge by each real portal in the form of virtual buses and virtual bridges, each virtual bridge comprising two virtual portals;

- emulating a global register of passband availability for the set of wireless links of the wireless bridge;

- reserving passband with the global register for the virtual buses representing each wireless link participating in a communication between two real portals.

2. Process according to Claim 1, characterized in that a wireless link is modelled in the form of a virtual bridge.

3. Process according to Claim 1, characterized in that a wireless link is modelled in the form of a virtual bus.

4. Process according to Claim 1, characterized in that a group of wireless links linking a group of portals having complete connectivity within a bigger network with partial connectivity is modelled in the form of a virtual bus.

5. Process according to one of Claims 3 or 4, characterized in that each real portal emulates;

- a virtual portal forming together with the real portal a bridge linking the communication bus connected to the real portal to a virtual so-called internal bus also emulated by the real portal;

- a virtual bridge for each wireless link with another real portal.

6. Process according to Claim 2, characterized in that each real portal emulates:

- a virtual portal forming together with the real portal a bridge linking the communication bus connected to the real portal to a virtual so-called internal bus also emulated by the real portal;

- a virtual portal for each wireless link with other portals of the wireless bridge, two virtual portals corresponding to the same wireless link between two real portals forming a virtual bridge representing the wireless link.

7. Process according to one of Claims 4 or 5, characterized in that it furthermore comprises the step of eliminating an internal bus and virtual portals connected thereto, and of contracting into a bridge the two orphan portals thus created, in the case where the real portal comprising the internal bus forms part of a single wireless link.

8. Process according to one of Claims 1 to 7, characterized in that it furthermore comprises the step of determining, by each real portal, the set of wireless links between the real portals.

9. Process according to Claim 8, characterized in that the step of determining the set of wireless links comprises the steps of:

- identifying, by each real portal, the other real portals whose data reach it directly;

- transmission destined for all the other real portals of the wireless network, of the list of real portals with which a direct link exists;

- reception of the list compiled by each of the other portals.

10. Process according to one of the preceding claims, characterized in that it also comprises the step of emulating a register of availability of isochronous channels for each virtual bus.

AMENDED SHEET

11. Process according to one of the preceding claims, characterized in that the step of reserving passband with the global register comprises the instigating of a request for reserving passband with a manager of isochronous resources of a virtual bus and for transmitting the request by the said manager of isochronous resources of the virtual bus to a software module managing the global register of passband availability.

12. Process according to one of Claims 1 to 11, characterized in that the bridge comprises at least three portals.

Abstract

The invention relates to a process for managing resources in a communication network comprising at least two communication buses linked by way of a wireless transmission bridge, the said bridge comprising for each bus a real portal connected to this bus, each portal being furnished with wireless communication means.

The process is characterized by the steps:

- modelling the said wireless bridge by each real portal in the form of virtual buses and virtual bridges, each virtual bridge comprising two virtual portals;
- emulating a global register of passband availability for the entire wireless bridge;
- reserving passband with the said global register for each wireless link participating in a communication.

The invention applies in particular in field of home automation.

Figure 2

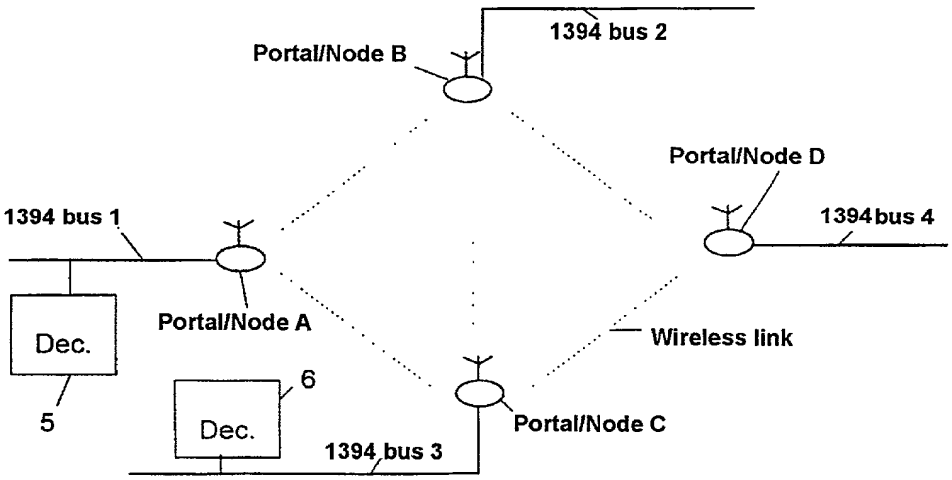


Fig. 1

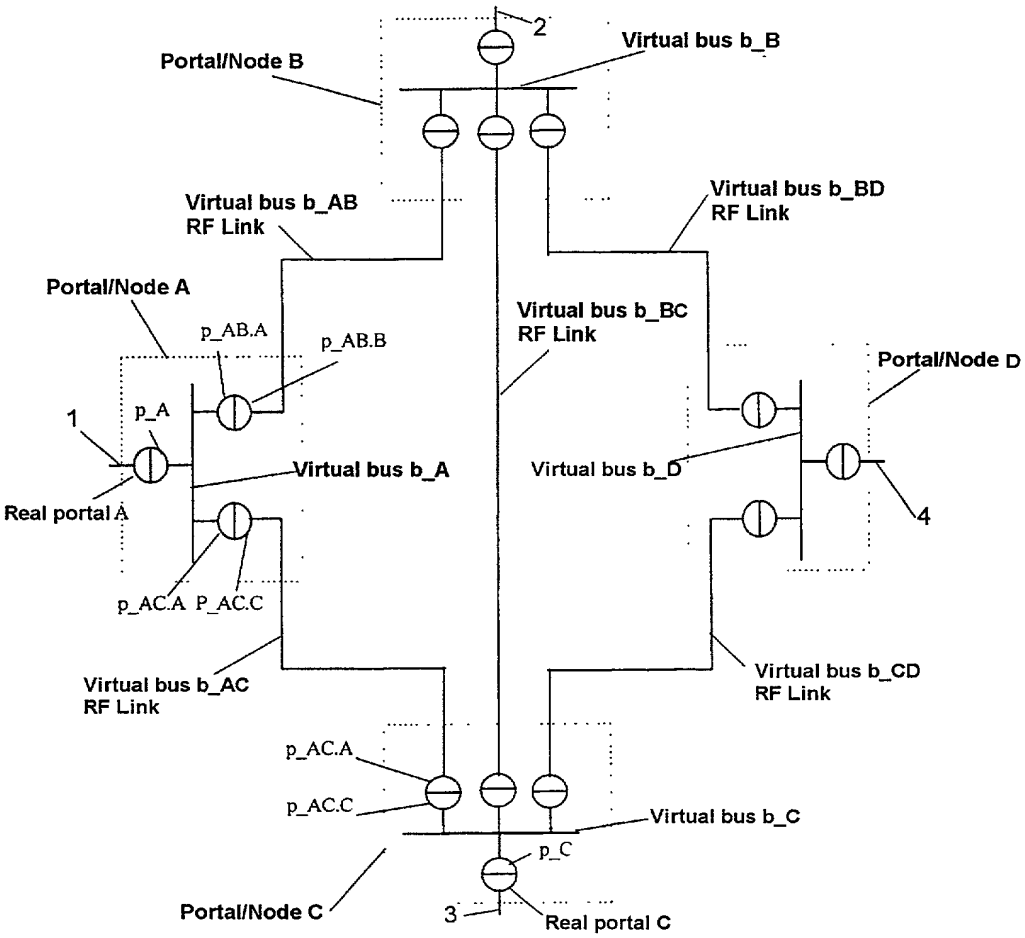

2
Virtual bus b_B
Portal/Node B
Virtual bus b_AB
RF Link
Virtual bus b_BD
RF Link
Portal/Node A
Virtual bus b_BC
RF Link
p_AB.A
p_AB.B
Portal/Node D
1
p_A
Virtual bus b_A
Virtual bus b_D
Real portal A
4
p_AC.A
P_AC.C
Virtual bus b_AC
RF Link
Virtual bus b_CD
RF Link
p_AC.A
p_AC.C
Virtual bus b_C
p_C
Portal/Node C
3
Real portal C

Fig. 2

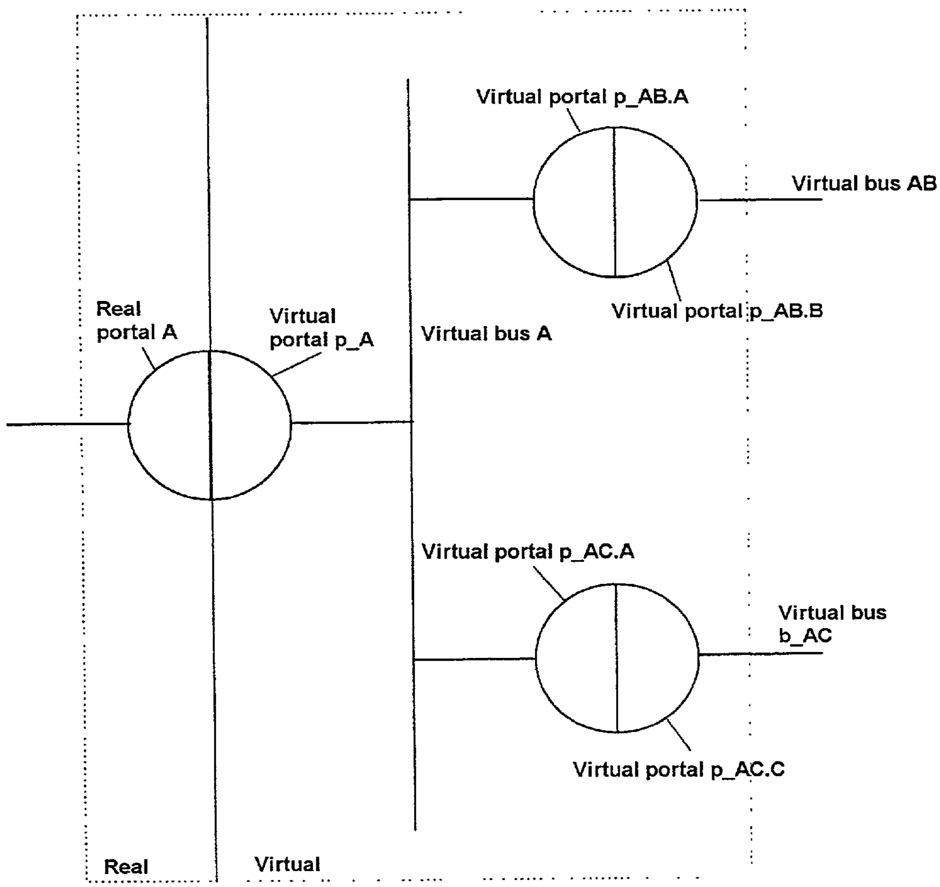
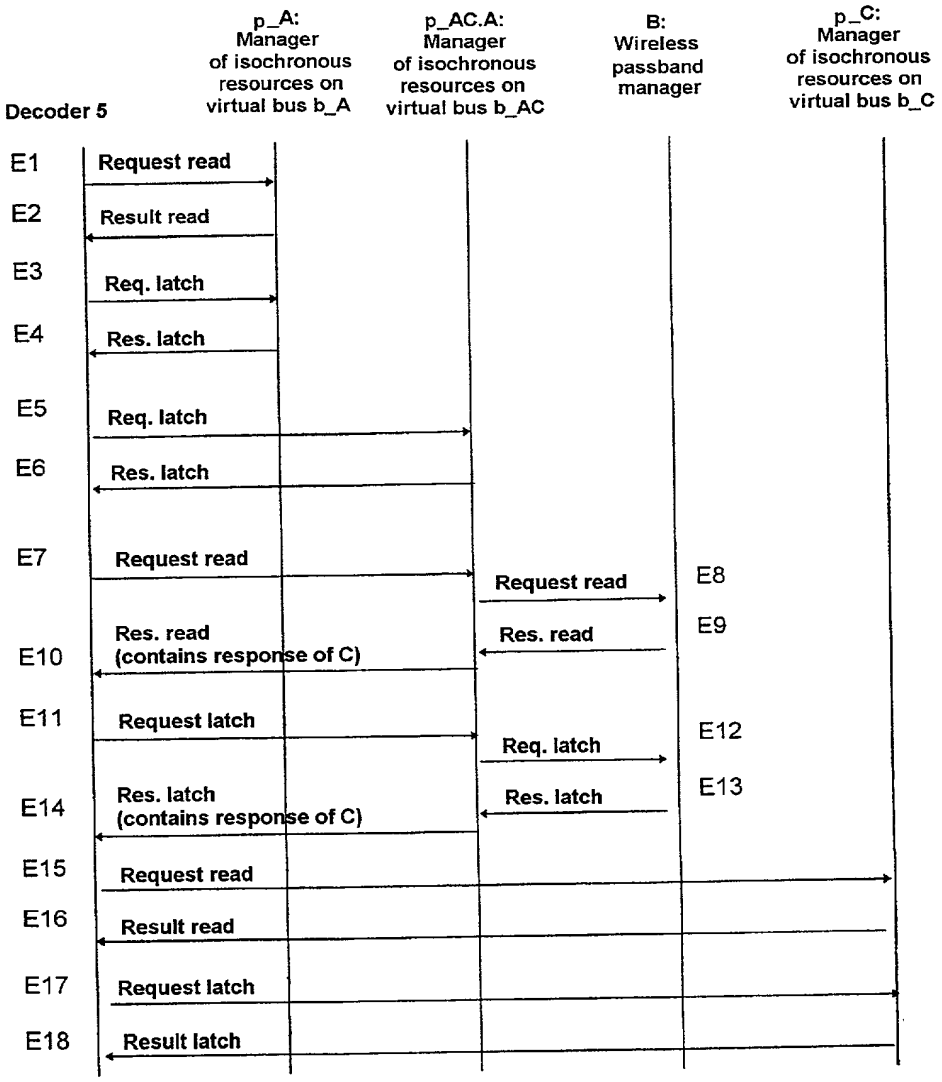


Fig. 3

Fig. 4


Decoder 5
p_A: Manager of isochronous resources on virtual bus b_A
p_AC.A: Manager of isochronous resources on virtual bus b_AC
B: Wireless passband manager
p_C: Manager of isochronous resources on virtual bus b_C
E1
Request read
E2
Result read
E3
Req. latch
E4
Res. latch
E5
Req. latch
E6
Res. latch
E7
Request read
Request read
E8
E9
Res. read
E10
Res. read (contains response of C)
E11
Request latch
Req. latch
E12
E13
Res. latch
E14
Res. latch (contains response of C)
E15
Request read
E16
Result read
E17
Request latch
E18
Result latch

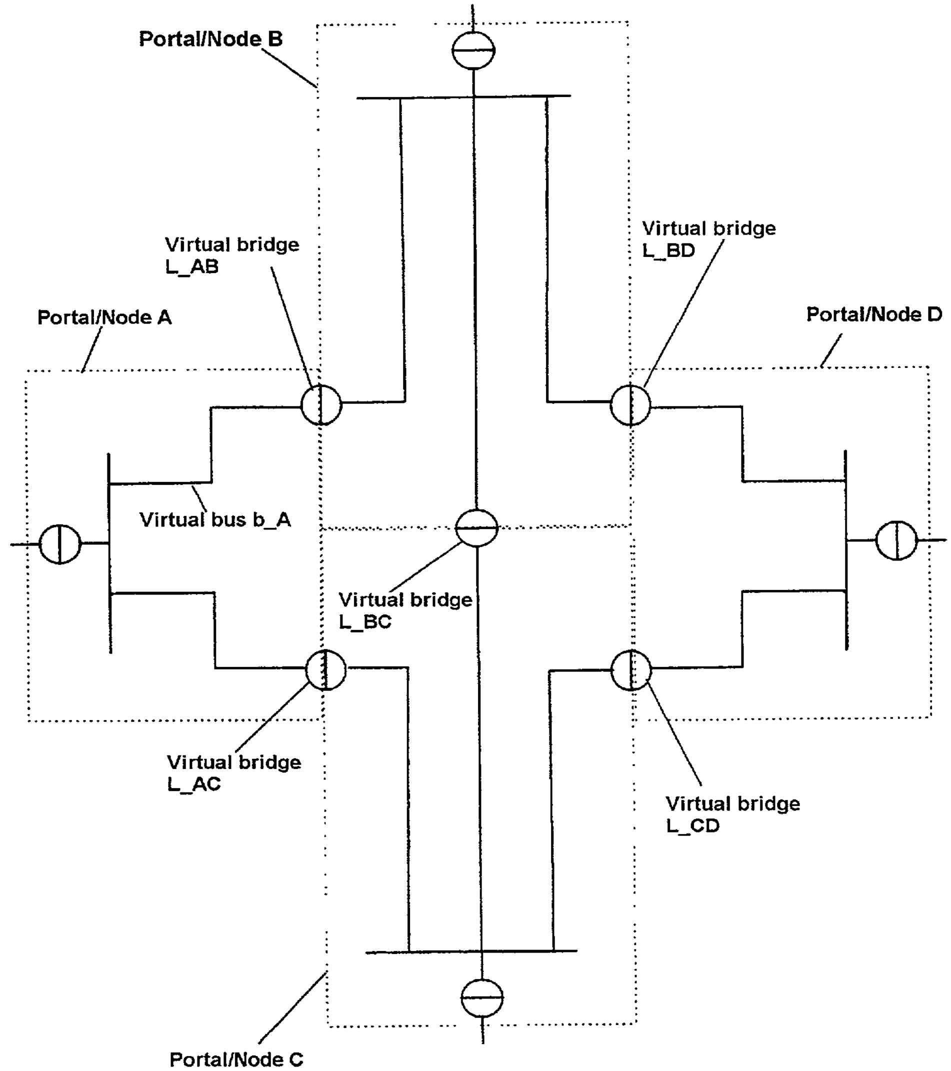


Fig. 5

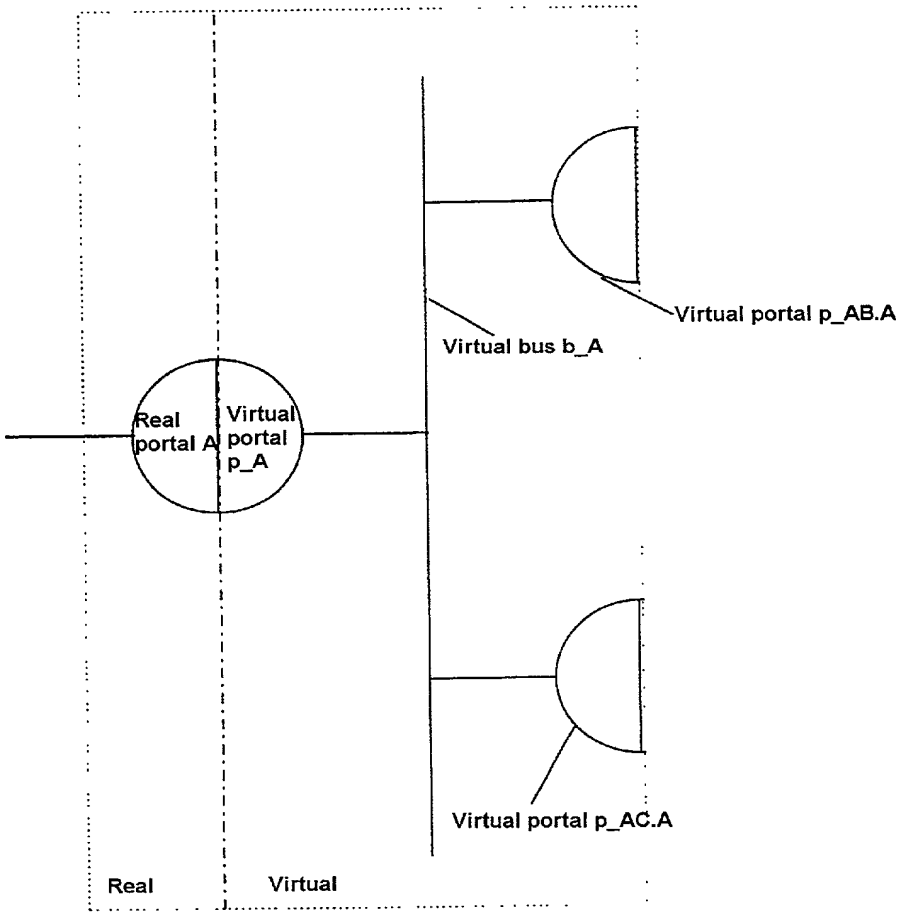


Fig. 6

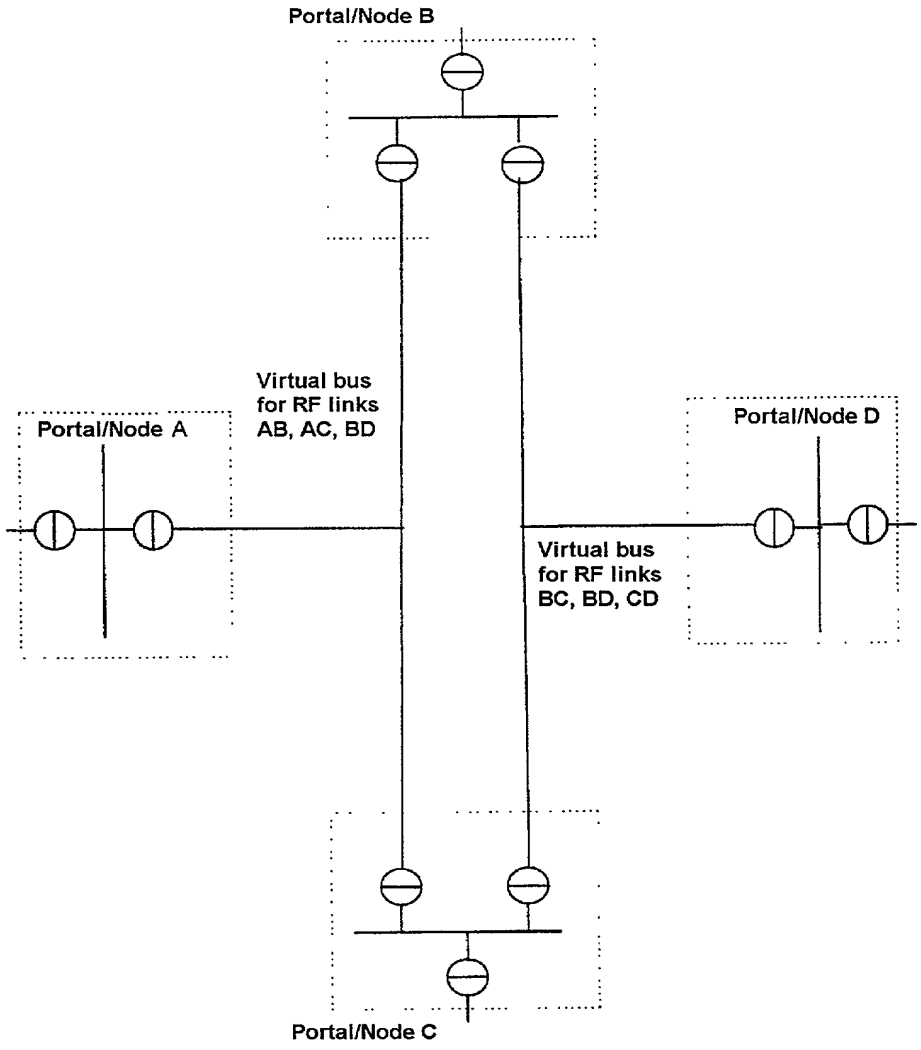


Fig. 7

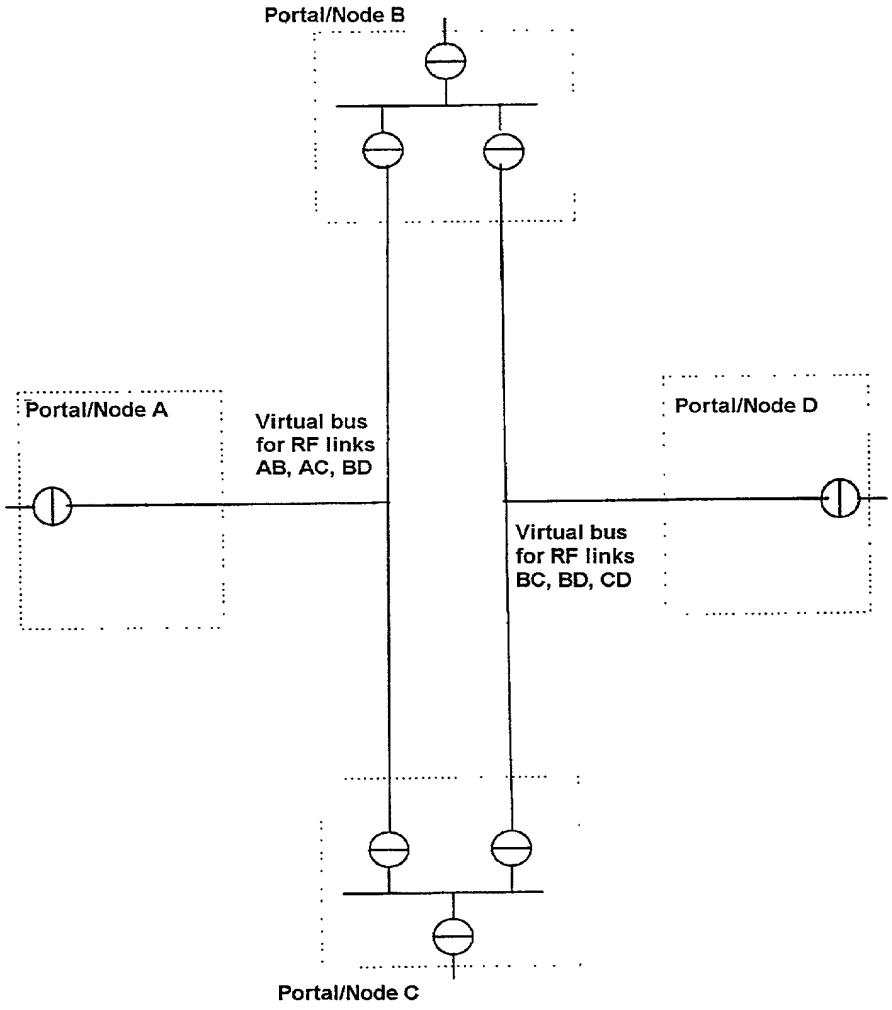


Fig. 8

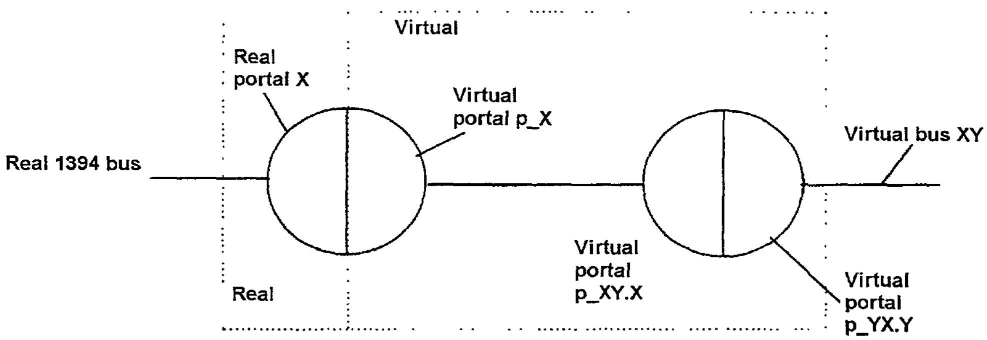


Fig. 9a

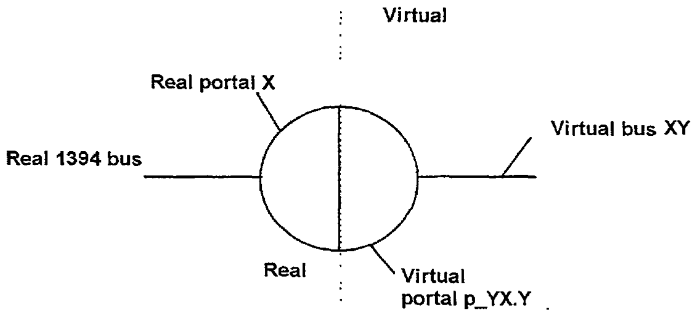


Fig. 9b

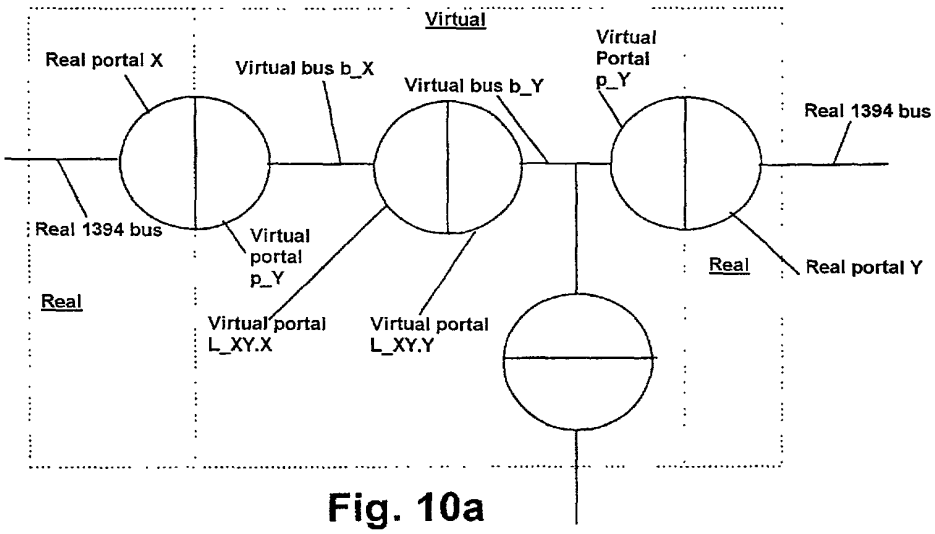


Fig. 10a

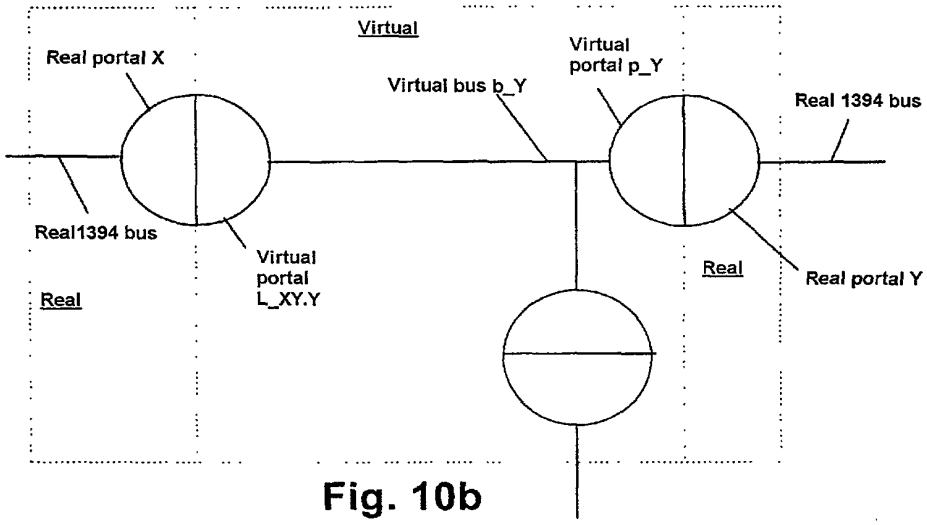


Fig. 10b

EXPRESS M. EL 685394495 US

PF980079

09/856063

DECLARATION FOR UNITED STATES PATENT APPLICATION,
POWER OF ATTORNEY, DESIGNATION OF CORRESPONDENCE ADDRESS

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and that I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Process for managing passband in a communication network comprising a wireless link

the specification of which
(CHECK ONE) ( ) is attached hereto.
(XX) was filed on May 17, 2001, Application Serial. No. 09/856063
and was amended on

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with 37 CFR 1.56(a).

I hereby claim foreign priority benefits under 35 USC 119 of any foreign application(s) for patent, utility model, design or inventor's certificate having a filing date before that of the application(s) on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
Number	Country	Date Filed	Yes	No
9814852	FR	November 25, 1998	xx	

I hereby claim the benefit under 35 USC 120 of any US Application(s) listed below, and, insofar as the subject matter of each of the claims of this Application is not disclosed in the prior US application in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose information which is material to the examination of this application in accordance with 37 CFR 1.56(a).

Serial No.: Filed:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under of 18 USC 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: Joseph S. Tripoli (Reg. No. 26,040), Dennis H. Irlbeck (Reg. No. 26,372), Eric Herrmann (Reg. No. 29,169) and Joseph J. Laks (Reg. No. 27,914) Telephone: (609) 734-9813.

Address all correspondence to Joseph S. Tripoli, Patent Operations - Thomson multimedia Licensing, Inc. - CN 5312 - Princeton, New Jersey 08543-0028

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United States Patent & Trademark Office

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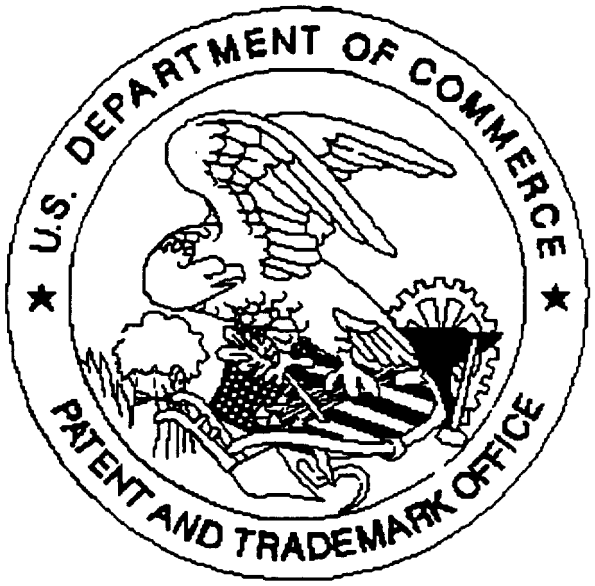

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